

Developing ethics and pro-environmental behaviors in PE: A mixed-methods research on an 8-month intervention study

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ABSTRACT: The objective of the Ecolo'coteaux intervention program was to facilitate the development of pro-environmental attitudes in a group of 70 children aged 10.1 ± 0.6 years enrolled in a school where most children come from a disadvantaged background. The children were randomly assigned to a test group ($n=42$) and a control group ($n=28$). The test group participated in a comprehensive outdoor education program, which combined Forest School and Adventure Education during the school year, in addition to their regular physical education classes. Before, during and after the intervention, the children were assessed using Bogner's survey (2018), which aimed to classify children's environmental attitudes into three categories: anthropocentric, neutral, and ecocentric. Self-confrontation interviews were conducted during the program to gather qualitative data. Quantitative results did not show significant changes in the overall results during the program. On the other hand, the enactive interviews showed that the nature conservation attitudes of all three profiles were strengthened. However, nature appreciation scores decreased among ecocentric and neutral students, as if regular contact with nature was a challenge for these students that led them to appreciate it less. Overall, this program offers insights into the potential benefits of outdoor education programs for promoting environmental awareness and fostering a deeper understanding of the natural world.

KEYWORDS: mixed-methods research (MMR), situated action, environmental ethics, Forest School, Adventure Education program

INTRODUCTION

The current Western lifestyle has proven to be unsustainable, having already crossed seven of the nine planetary limits identified by Wang-Erlandsson *et al.* (2022). Chemical pollution, CO₂ emissions, poaching, deforestation are just some of the causes of the alarming degradation of our environment, which is reflected in phenomena such as soil degradation, global warming and loss of biodiversity.

These major societal challenges require a significant change in our lifestyles and have led decision-makers, citizens and scientists to question the actions needed to achieve sustainable development. The 2015 Paris agreements laid the foundations for an ambitious agenda, in which education has a central place. Indeed, education for sustainable development is increasingly recognized as an imperative in the training of citizens throughout the world (UNESCO, 2014). Moreover, there is a growing apparent trend among the children of the Alpha generation, born after 2010, who seem to have more positive attitudes towards the environment and nature than earlier generations (WWF, 2020). For Kortenkamp & Moore, 2001 as well as Kopnina *et al.* (2012) one of the keys to effective sustainable development education is adopting an ethical approach. Negative attitudes towards nature are largely the result of an ethical stance that Callicott (1989) called anthropocentrism. Anthropocentric ethics, whether oriented towards self-interest or altruistic humanism, posits the moral superiority of humans over other species (Ehrenfeld, 1978). From an anthropocentric view point, the value of nature is instrumental, and non-human beings have no intrinsic value beyond their utility to humans (Lundmarck 2007). In contrast, an ecocentric ethical approach sees humans as an integral part of the biotic community and emphasizes the importance of 'the multiplicity of networks of interdependence that link humans and non-humans' (Larrère, 2010). Individuals adopting these attitudes tend to assign an intrinsic value to the natural environment, regardless of its possible economic utility (Kortenkamp & Moore, 2001; Kopnina *et al.*, 2012). However, developing ecocentric attitudes requires frequent and regular contact with nature (Meech, 2014 in Turtle *et al.*, 2015; Armstrong & Impara, 1991), in order to foster what researchers call an attachment to place (Scannell & Gifford, 2010) and a sense of connection (Lumber *et al.*, 2017). Regular exposure to nature, when it occurs, generates many benefits. In a literature review, Strife & Downey (2009) show that access to nature and green spaces provides children with a multitude of cognitive, emotional and physical benefits. Furthermore, regardless of ethnicity and socio-economic status, early childhood experiences in nature have a significant influence on the development of lifelong environmental attitudes and values.

Unfortunately, children from disadvantaged urban socio-economic backgrounds often have less opportunity to be exposed to the natural environment (Rehling *et al.*, 2021), which tends to reinforce inequalities in access to nature and hinder the development of pro-environmental attitudes. Due to its universal character, school appears to be an ideal place to educate for sustainable development by ensuring that every child, especially those from disadvantaged social backgrounds, has contact with nature. School nature based programs

could encourage the emergence of an ecocentric ethic, a prerequisite for the adoption of pro-environmental behaviour (Kopnina *et al.*, 2012).

Among the pedagogical formats for developing this link to nature, the Forest School and Adventure Education (AE) appear to be promising prospects. The Forest School concept, which originated in the Danish Udeskole, proposes to immerse learners in a natural environment and to use resources available as a support for the day's lesson in different school subjects (Waite *et al.*, 2016). Turtle, Convery & Convery (2015) showed in a randomised controlled trial that children in the program developed 'forest exploration behaviors with high levels of engagement and enjoyment' marked by a 'growing interest in environmental issues and for protecting the planet' compared to the control group. On the other hand, Priest & Gass (2017) define AE as "a branch of outdoor education that (...) uses adventure activities (...) involving group problem solving and personal challenge". Brymer & Gray (2010) show that AE also allows, through connection to nature, the development of ecocentric values generating more protective behaviors towards nature. While Forest Schools generally cover all subjects, AE is more specifically focused on physical education. Together, these school-based pedagogical formats offer an interesting potential for developing ecocentric attitudes. However, to our knowledge, no study combines Forest School and AE over a long period of time in a disadvantaged school setting while focusing on the experience of participants. The aim of this study is to determine the effect of a program combining Forest School and AE on the environmental attitudes of primary school children from disadvantaged socio-economic backgrounds, and then to analyze the experiences, emotions and knowledge built towards nature through this interventional program. The originality of our study is to propose a double methodological and theoretical approach based on identified environmental attitudes found in specific literature and on the pupils' experiences in action within this particular program over the course of one year. The concept of experience and this temporality are often absent from literature on Forest School or EA and more generally on studies on ecological education.

THEORETICAL AND METHODOLOGICAL FRAMEWORK

In order to understand the cognitive process of students in nature, we used a mixed approach in the framework of physical education (Vors & Bourcier, 2022). It falls within the field of psychology by crossing quantitative methodologies based on a statistical analysis of data from a psychometric questionnaire (Bogner, 2018) with qualitative methodologies based on phenomenology from the course of action research program (Poizat & San Martin, 2020; Theureau, 2015). The psychometric approach is based on a dualistic ontology and measures traits related to environmental attitudes. The enactive approach is based on a monistic ontology and considers psychological traits as emerging from the interaction between the individual and his/her environment. These ontological differences provide a juxtaposed and complementary perspective that makes it possible to identify measurable effects of a programme while at the same time accounting for the subjective relationship between a type of actor and his / her

environment. In other words, this dual perspective makes it possible to compare environmental attitudes and experiences in a natural environment in order to better understand the child's behavior. This mixed-methods approach that provides two different perspectives on environmental behavior in a natural environment over the course of one year.

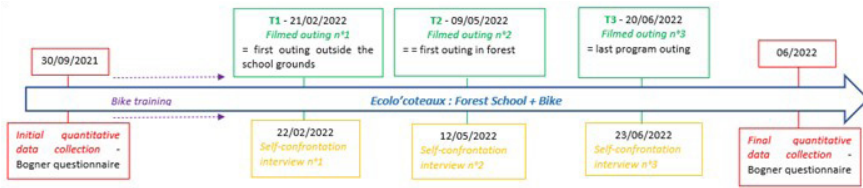
In agreement with the school inspector, the school director and the parents, the study recruited 70 pupils to participate in the educational program *Ecolo'Coteaux*, involving a control class and a test class. Parents were informed and gave written consent for their children to participate. A school located in a reinforced priority education network (REP+) in the North-East of France volunteered to participate in this study. The social position indicator (SPI=65.8) confirmed the disadvantaged nature of this school, placing it in the 9th decile nationally. This interventional study was designed jointly with the teacher in charge of the class, a state-certified cycling instructor, a representative from the Ministry of Sport and two researchers. Only four students in the control group declined to participate. The characteristics of the program are summarized in Table 1.

Table 1: description and distribution of children in control and test groups

Year	Age	Number (n=)	Boys (n=)	Girls (n=)	Control (n=)	Test (n=)
Total	10.1±0.6	70	36	34	28	42
20/21	10.2±0.6	34	18	16	13	21
21/22	10.0±0.6	36	18	18	15	21

The study was conducted over a period of one year, once a week for 4 hours every Monday morning. The *Ecolo'coteaux* educational program was designed by combining two innovative teaching approaches: Forest School and Adventure Education. In the Forest School phase, the teacher took the students to natural environments to teach them subjects other than physical education (PE). For example, students studied biology, and explored the forest to take notes on different plants and animals, interview local experts to learn how to observe their environment, collected data and presented it in creative ways. Mountain biking lessons, taught by a specialized teacher, were also offered as a subject outside of PE. The instructional design adopted was based on the principles of Adventure Education, which emphasises experiential learning, outdoor activities, collaboration, risk-taking, reflection and safety to foster students' personal and social development. The teachers adopted a student-centered approach, with group tasks adapted to the needs of the children. The mountain bike tasks were mainly focused on mastery rather than competition, thus encouraging mutual support and co-dependence to strengthen group cohesion. The teacher used the natural environment to stimulate exploration, and each daily lesson was designed around this environment. Specific instructions were given to the students at each stage to explain the rules and reasons behind the teaching approach. Figure 1 illustrates the intervention scheme.

Figure 1 : Timeline of the intervention system and the different stages of data collection



The Forest School and Adventure Education teaching approaches were applied successively or simultaneously in six one-day trips organized as part of the program. The students used the bicycle as a means of transport to get out of the city and into the forest where they received their lessons for the day. The use of bicycles combined outdoor activities with academic learning and encouraged the pupils to actively explore their natural environment and learn more about the nature around them. The precise program of the three daily outings we filmed for our qualitative data collection can be found in Table 2.

Table 2 : Content of filmed outings

	T1 : Outing 1	T2 : Outing 2	T3 : Outing 3
EA/VTT	Rolling in water, in mud, in fields.	Riding on a narrow trail. Up and down slopes in the forest.	Riding on a narrow trail. Going up and down slopes in the forest. Cross a river.
Forest School	Educational activities at the Moulin de Lutterbach with supervisors: <ul style="list-style-type: none"> • Workshop on building a bird nesting box + discovery of tools and how to use them • Birdwatching workshop + discovery of binoculars • Workshop to discover the knife tool and how to use it on wood + raising awareness of negative attitudes towards the environment (don't tear off tree branches). 	French: Write a letter from a WWI soldier in the forest + decorate your letter using elements from the environment.	Self-assessment of cycling skills. Waste awareness EPS: Introduction to "Parkour" in the forest.

1. Quantitative analyses: Evolution of children's attitudes towards nature

Bogner (2018) proposed and validated a 21-question questionnaire to analyze the evolution of environmental attitude scores of children aged 7 to 12 years by identifying three distinct dimensions: preservation, use and appreciation. Preservation (PRE) is defined as "a bio-centric dimension reflecting conservation and protection of the environment". Use (UTL) is "an anthropocentric dimension whose values are reflected in the use of natural resources". Appreciation of nature (APR) 'can easily be seen as a positive attitude towards

nature, as the appreciative component in the environmental attitudinal is an important part of it' (Bogner, 2018).

Attitude scores before the start of the program and at the end of the program were compared for the test and control groups. Descriptive statistics were used to identify initial profiles of ecocentric (Quartile 4, high score), neutral (Quartile 2 and 3, medium score) and anthropocentric (Quartile 1, low score) children. Nine children were pre-selected (3 per profile). The teacher then selected one child per profile to participate in the self-confrontation interviews based on criteria related to their level of oral comprehension of French and their ability to engage in dialogue with the researcher. We also asked the teacher to recommend pupils for the study who were well integrated into their social environment, so that they would be representative of the sociology of the school. Imran¹ (10 yo) (anthropocentric actor), Oscar (10 yo) (neutral actor) and Emma (10 yo) (ecocentric actor) were therefore selected to represent their ethical profile.

Inferential statistics were used to complement the analysis of the psychometric questionnaire. Different initial conditions were analyzed: normality of the distribution, homoscedasticity (Bartlett test) and sphericity (Mauchly test). When the sphericity hypothesis was not verified, the Greenhouse-Geisser correction was applied. The analysis of variance for repeated measures, followed by a Tukey's post-hoc test to locate possible differences was then performed. The dependent variables were: total questionnaire score ($=[\text{PRE}+\text{APR}]-\text{UTL}$) and the different scores in each of the questionnaire dimensions; independent variables: group (test or control), time (before/after intervention). For all tests, the significance level was set at 5%. The effect size was considered small for $\eta^2_p < 0.06$, moderate for $0.06 < \eta^2_p < 0.14$, strong for $\eta^2_p > 0.14$.

2. Qualitative analyses: analysis of the experience of students in the Ecolo'coteaux programme

An explanatory sequential design (Creswell & Plano Clark, 2018) was conducted to select the students participating in the qualitative study within the Ecolo'coteaux program. Students were ranked according to their total score on the environmental attitudes questionnaire. The three pre-selected students conducted self-confrontation interviews (Theureau, 2015) aiming to understand their experiences at three periods of the program (T1 = first outing outside school, T2 = first outing in the forest, T3 = last outing).

The self-confrontation interviews were analyzed using the classical method of reconstructing the course of experience through hexadic sign analysis (Vors *et al.*, 2019). In this way we identified common and specific characteristics of the experience between the different student profiles as well as its dynamics during the program. This identification was based on the analysis of the different typical components of the students' experiences.

The typical character of the experience refers to four aspects according to Durand (2014): descriptive (i.e. the typical event presents the greatest number

¹ First names have been changed to respect the anonymity of our three actors.

of attributes of the activity observed in the sample of actors and situations studied), statistical (i.e. the typical event is the most frequently observed in the sample studied), generative (i.e. the typical occurrence has a propensity to emerge when conditions resembling those observed recur), and significant (i.e. actors express a sense of typicality when asked about it in a self-confrontation interview). In particular, we looked at engagement (E) (to find out whether the concerns are rather nature-oriented, self-oriented or both), representativeness (R) (to find out on which natural or non-natural elements the student acts), potential actuality (A) (to find out whether the actor's expectations are anthropocentric or ecocentric), the referential (S) (to know if the student has already constructed meanings of the relationship between man and nature in his past experiences) and the interpreter (I) (to know what the student has learnt during the action, which will indicate a potential development of attitudes) for each given elementary unit (U).

3. Mixed analyses

For our three actors, data processing was carried out simultaneously and in a dialogical manner by combining quantitative data (from the questionnaire) with qualitative data (from the analysis of the interviews). The self-confrontation interviews provided pertinent information on the lived experience of the actors at a specific moment in the program. The quantitative results provided information on certain salient individual features of their experience. Despite the different theoretical bases of the questionnaires, the extreme individual scores on the Bogner scale ("strongly disagree", "strongly agree") were considered qualitatively significant. This is because if the student self-reports a high or low score, it reflects a salient experience (Escalié, 2019). Following the research program course of action, the act of filling in this questionnaire requires the child to put himself or herself in a situation (Girard, 2022) in order to position himself or herself in relation to his or her past relationship with a natural environment. Thus, in order to fill in the questionnaire, the child had to mobilize past experiences from before the program and from after the educational program.

In conclusion, this mixed approach proposes a juxtaposed analysis at the theoretical level of environmental attitudes and experiences of interaction with nature within the Ecolo'coteaux program over one year. We took this mixed approach further, using the results of the questionnaires to 1) articulate these methods to select the three participants with different environmental attitudes, and 2) articulate the data to cross-reference the experiences from the self-confrontation interviews with some of the salient self-reported experiences from the questionnaires.

RESULTS

Quantitative results for the class: no significant effect of the educational program on changes in students' environmental attitudes were found.

The results of the questionnaire responses (Table 3) show a hierarchy of factors (preservation>appreciation>use) and orders of magnitude similar to that noted by Maurer and Bogner (2020) for a similar age population.

The repeated measures ANOVA did not identify any significant effect between groups ($F_{1,66} = 2.1$, $p=0.15$, $\eta^2_p=0.02$), time ($F_{1,66} = 0.84$, $p=0.36$, $\eta^2_p=0.002$), or group×time interaction ($F_{1,66} = 0.27$, $p=0.60$, $\eta^2_p<0.01$: Figure 2 and Table 3). Analysis of the dimensions (appreciation, protection, use) of the questionnaire also revealed no significant differences for the test and control groups between the beginning and end of the program.

Figure 2 : Results of the Ecolo'coteaux program's impact on environmental attitudes measured using the Bogner questionnaire

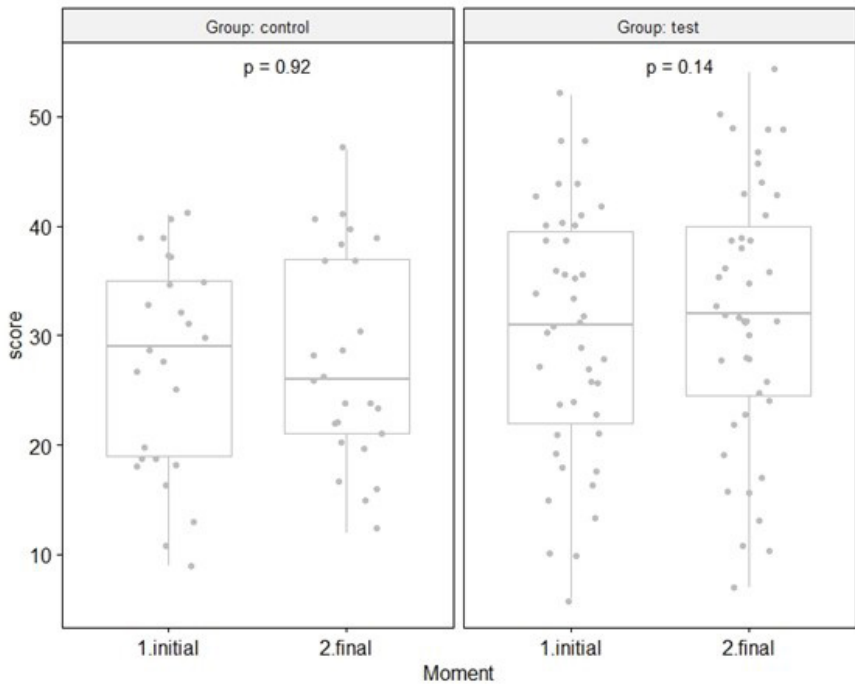


Table 3 : Evolution scores on the Bogner questionnaire and its sub-dimensions for our test and control groups

	Test Group		Control group	
	Initial	Final	Initial	Final
Total	4.3±1.6	4.6±1.7	3.9±1.4	4.0±1.4
	NS		NS	
Appreciation	3.4±0.9	3.4±1.1	3.0±1.0	2.7±1.0
	NS		NS	
Preservation	3.6±0.9	3.7±0.8	3.6±0.8	3.9±0.6
	NS		NS	
Utilisation	2.7±0.6	2.5±0.7	2.8±0.7	2.7±0.8
	NS		NS	

CROSS-REFERENCING OF THE PSYCHOMETRIC AND ENACTIVE DATA ON THE THREE STUDENT PROFILES

The descriptive statistics from the previous phase made it possible, with the help of the teacher, to select three actors representative of three environmental ethics. The analysis of the scores of the different dimensions of Bogner's (2018) questionnaire and their evolution during the program among these three students (Table 4) reveals the existence of a contrasting evolution, particularly on two of the dimensions "protection" and "appreciation" of nature. The qualitative analysis of the students' lived experience and its dynamics sheds light on these changes. The interaction with the environment is accompanied by positive experiences with natural elements of the environment where nature is appreciated and negative experiences with natural elements of the environment where nature is considered hostile.

Table 4 : Evolution of scores on the Bogner questionnaire and its sub-dimensions for our 3 actors (Global score = APR + PRE – UTL)

Profil	Ecocentric		Neutral		Anthropocentric	
	Initial	Final	Initial	Final	Initial	Final
Global	7.7	7.0	4.6	4.4	1.4	3.7
Appreciation	4.7	3.9	3.7	2.3	1.1	4.4
Preservation	4.1	4.9	3.0	3.9	2.9	2.9
Utilisation	1.1	1.7	2.1	1.7	2.6	2.7

A living, fragile and beautiful nature that must be protected

The typical experiences of our three actors. Qualitative analyses show that these students were concerned with protecting nature, which they perceived as fragile, living, and at times beautiful. This is reflected in the elementary action units (U) of our three profiles (e.g., building a birdhouse) and also in their typical commitments (e.g., preserving nature). For example, Imran "avoids breaking trees" (E), Emma acts in a way that "doesn't crush the animals" (E), and Oscar explains "it was kind of protecting them because they (the plants) didn't do anything" (E). Our three students, despite their different environmental ethics, showed to have empathetic relationships which took into account the natural environment. In action, the students put themselves in the place of natural elements by granting them human properties, which is transcribed for example in their representation (R): "don't / you shouldn't tear off tree branches. , It's as if someone was tearing off your arm", "they are alive if, for example, if we crush plants, they hurt".

This relationship with nature is built in action and according to past experiences. Indeed, Emma, through her experiences in nature, already wanted to "grow a stick" (A), which led her to build knowledge (I) about the environment's needs for life: "I know that it doesn't grow back! [...] Because it's already broken. And in your opinion, for a tree to grow again, what is needed? A seed and water... roots." (I). Oscar mobilized his past knowledge, he relates his past

experiences where he tended not to respect the environment in his youth. Through interactions with peers, he became aware that human actions can have a harmful impact on nature and uses his lived experience as a reference point (S): "well uh well sometimes when I was little when I did that (pulling branches off trees) well I didn't know uh and when a friend told me not to do it well it got me." He was not aware of the consequences of his actions, he did not realize the impact that some of his actions could have on trees and animals as this excerpt shows: "It was my mother when I was a child and when I threw my waste on the ground afterwards she told me to throw it in the garbage because afterwards the animals could eat and afterwards they could choke" (S).

The dynamics of the experience of our three actors. The dynamics of the students' experience reveal typical changes showing a growing concern for nature protection. These qualitative results enable us to go further into the dynamics of the lived experience of the three children, whereas the overall quantitative results on all the students in the class did not show any change in environmental attitudes. To present these qualitative results based on the dynamics of the experience, we will cross-reference the self-confrontation data with the individual scores of the three profiles corresponding to salient experiences (Table 4).

The dynamics of Emma's experience were increasingly focused on the preservation of elements of the natural environment. Qualitatively, the phenomenological analysis highlights an evolution of Emma's typical concerns (E). During the first outing, she voluntarily rips off a branch (T1) because she is concerned about not getting dirty (E). For the requested exercise she did not want to choose a dead branch covered with mud (R). Her concerns typically shifted during the program to protecting elements of the natural environment (e.g., insects, branches). For example, she acts in such a way as not to harm insects (E) even if they are on her leaf (R) (T2) and not to tear off branches (E) even if they are in her path (R) (T3). Her relationship to nature evolved; if at first she considered herself dominant over nature at the beginning of the program, at the end of the program she gave an ecocentric response to the statement "humans are not more important than other creatures". This evolution of Emma's experience occurred in interaction with natural elements and in interaction with the teacher and her peers. There was no particularly striking or exceptional event; the dynamics of her experience were built up as she immersed herself in nature, accompanied by ecological reflection on the part of the teacher. These interactions through the action brought about knowledge that allowed her to appreciate nature (e.g., nature is beautiful), and to protect it (e.g., nature is fragile, we must not hurt it).

The qualitative results of Emma's course-of-experience analysis are consistent with some of the questionnaire results. Her score on the 'preservation' dimension increases from 29 points to 34 points between the beginning and the end of the program (Table 3).

This dynamic of environmentally oriented experience is mirrored in Imran, whose commitment to protecting nature became more and more frequent as the program progressed. The analysis of his experience in T1 showed no preoccupation with nature and his environment during the first outing. Later, he humanizes the pain of trees (R) as he feels concerned about humans using

nature as a "dump" (E) (T2) and he shows concerns about preserving nature (E) by seeing it as fragile (R), especially in regards to the impacts of pollution (T3). This evolution of experience is also reflected in his quantitative scores considering "humans are not more important than other creatures". His score in T1, the most anthropocentric, evolves towards an ecocentric response at the end of the program in T3.

Finally, for Oscar, the Ecolo'coteaux program allowed him to reinforce his concern for the preservation of the environment, which was already present before the program. Qualitatively, this trend is reflected in his typical commitment to not harming nature (E). This translates into actions that avoid pulling down tree branches (U) or else "the birds get wet, they have no shelter" (R) (T1), or protecting the nettles (U) and not killing the ant (U) (T2), or not throwing away waste (U) (T3) or else "the birds may think it's food, but then they may choke" (R). This concern for protection, which became more and more pronounced, is reflected in the quantitative results, where Oscar's score on the "preservation" dimension rose from 21 to 27 points at the end of the program.

In general, the program initiated a process of protection in our three actors, even if Oscar before the program had already taken into account that human actions could have a negative impact on the environment. However, if preservation concerns appear at certain moments in the program, attitudes of non-protection anchored in daily habits from his family remain. For example, Imran kills flies (U) because he feels that they provoke him: "if they provoke me, I swat them" (E) and "my mother told me to kill them" (S). Thus, while the curriculum for these fifth graders began to show a desire for greater preservation of nature, the concerns that characterize the anthropocentric ethic remained prevalent throughout the curriculum.

When nature is hostile and dirty it becomes an obstacle that constrains my action

The typical experiences of our three actors. The enactive interviews highlight a typical perception of natural elements as a constraint, especially when they perform actions for the first time (e.g., during mountain bike trips: crossing a river, riding on a narrow path, going down a steep slope in the forest, ...).

More specifically, for Emma, nature was something hostile ("great emptiness", "toad drool" (R)) that made her feel fear or anxiety (E) frequently throughout the program. This perception of nature led her either to construct safe actions ("I put my feet on the side so I don't fall" (I)) or to abandon her action: "I cannot remove the bark anymore because of the branches, I've had enough, I'm quitting" (I), or when mountain biking "I couldn't ride on the grass" (E), which led her to get off her bike. This fear and anxiety felt constantly throughout the program led her to a depreciation of nature, which we can also see in the decrease of her score from 33 to 27 points in the dimension 'appreciation'.

In the same way, Omer was preoccupied by the fact of being hindered (E) by a natural environment seen as an obstacle to his will to progress as he would have liked to (A), as we can see in his representations: "it was the puddle of water that was slowing me down" (R), "(the branches) were blocking me uh so that I couldn't move forward" (R). It is his past experiences that have built up this

frame of reference of nature as an obstacle, from which he mobilizes knowledge (S) to respond to the action: "the stones are also an obstacle for me [...] because the last time it was because of a stone that I fell" (S), "well that (the roots) almost made me fall" (S). We understand that this student has had bad experiences in the past in nature, which he then considers dangerous, and this leads him to construct actions that avoid nature (I) in order to maintain a certain distance from it: "and now, I have decided to calculate the objects as if they were obstacles". This desire to remain at a distance from nature is found at the quantitative level when he goes from 26 to 16 points in the dimension of appreciation of nature.

Finally, Imran also frequently highlights the constraining nature of the natural environment in his representations: "I felt I couldn't do it or I would fall", "the puddle made me slip, it was hard" (R). But, unlike the other two profiles who give up or avoided the action, the anthropocentric actor was preoccupied with confronting obstacles he perceived in nature (E): "I told myself I was going to crush everything" (E). We understand that Imran was preoccupied with showing that he is the strongest and had to dominate nature. The environment was perceived as a challenge and at time disturbed him. For example, he hits insects with a stick (U) for his own personal pleasure: "that will teach them, it feels good". This perception of nature as challenging him is quantitatively reflected in his increase from 18 to 25 points in the dimension 'use of nature'.

The dynamics of the experience of our three actors. The evolution of the experience during the educational program is specific to each profile and sometimes even shows a divergence between the quantitative and qualitative results.

For Emma, her interaction with natural elements in her environment often refers to an image of nature being "dirty" (R) which evolves throughout the program to an understanding that nature is not necessarily "dirty" (I). At the beginning of the program (T1) she tears off a treebranch (U) so not to dirty her hands (E). With the Forest School and the AE (outings mountain bike), she accepted more and more to go in contact with nature, "I just wanted to do a somersault (E) and there are even natural elements which do not disturb me any more (T3), "it disturbs me more now all the pavement we have all the time when we ride our bikes" (I). We can therefore claim that the program allowed Emma, our ecocentric actor, to enter into a process of contact with natural elements through a transformation of her knowledge of what is clean or dirty.

For Imran, the program experience is structured by the typical commitment to dominate nature, to show it "that I am the strongest" (E). More precisely, his typical comments testify to the relationship of domination he has with nature, frequently considering it, , as a playground (Shoham, Rose, Kahle, 2000): "to have fun with it" (T1), "if it provokes me I hit it [...] That will teach them, it feels good" (T2), "there I am having fun going over a big rock, it's funny!" (T3). Imran likes to be in nature to have fun and enjoy himself. This is confirmed from a quantitative point of view when he goes from 8 to 31 points in the appreciation dimension at the end of the program. Our qualitative results therefore show that Imran's experience is marked by a playful relationship with his natural environment. This is reflected in his quantitative scores corresponding to an increasingly anthropocentric attitude.

Finally, we observe a convergence between the qualitative and quantitative results for Oscar, who adopts a constant defensive posture towards nature. Looking at his representations, we find that he attributes negative emotions to his contact with natural elements: "the puddle of water got me wet" (T1), "I was bumping into trees, where sometimes there were nettles that stung me and also all those leaves that bothered me" (T2). His experiences, particularly of fear and pain (E), are marked by a depreciation of the natural environment, which is felt in his interpretations: "it stings after it hurts and also after it makes you want to scratch", "well after I hurt myself. Yes, I was a bit scared too", "I don't know, I panicked", to finally conclude that "the city is better because in the forest it's just that there are a bit too many roots" (I). This led him to adopt a defensive posture towards the natural environment in order to keep his distance from it, which can be seen in a significant way in the quantitative evolution of his score on "the tranquility of nature makes me anxious", where he goes from the most ecocentric response to the most anthropocentric response at the end of the program.

DISCUSSION AND CONCLUSION

This research aimed to study the evolution of environmental attitudes (at the quantitative level) and the dynamics of experience in relation to the natural elements of the environment (at the qualitative level), in children from disadvantaged backgrounds through an educational program combining two pedagogies of immersion in natural environments. We also combined methods to analyze the results: the psychometric approach, based on a dualistic ontology measuring the evolution of a trait related to the environmental attitude, and the enactive approach, based on a monistic ontology considering the psychological traits as emerging from the interaction between the individual and his or her environment.

These ontological differences enabled us to obtain a cross-sectional view of the measurable effects of a program while accounting for the subjective relationship between the actor and his or her environment. Here, these complementary methods offer an in-depth analysis of the evolution of environmental attitudes among children from disadvantaged backgrounds who have generally less access to natural spaces compared to children from more affluent background (Rehling *et al.*, 2021). It therefore seemed particularly interesting to carry out this educational program in a school where most children came from disadvantaged backgrounds (REP+), in collaboration with a motivated teaching team that was aware of the challenges of sustainable development.

The use of this mixed methodology allowed, on the one hand, the selection of emblematic participants from the profiles for further study through an explanatory sequential approach (Creswell & Plano Clark, 2018). On the other hand, the mix of data (quantitative and qualitative) allowed for juxtaposition of perspectives on the evolution of behaviors related to the natural environment of elementary-aged children over the course of this program (Greene *et al.* 1989). Specifically, analysis of the data reveals changes in their feelings, thoughts,

and behaviors toward the environment and nature. The combination of frequent immersion in the natural environment, the development of motor skills to move through it (adventure education), and the sensitive approach offered by the Forest School likely allowed students to develop knowledge, interpreters (I), important predictors of engagement in pro-environmental behaviors (Scharenberg *et al.*, 2021).

The program then enabled them to adopt environmentally friendly behaviors in action, in particular by building a nature protection reference frame (S). The analysis combining psychometric questionnaires and enactive interviews of the students most representative of the three profiles (Imran - anthropocentric, Oscar - neutral, and Emma - ecocentric) reveals, however, a contrasting evolution concerning the emotional experience of the students and the level of environmental awareness that they have developed.

The results of this mixed-methods approach lead to a paradox not previously seen in the literature. Students' activity during the program is marked by typical conflicting perceptions of nature: nature that should be protected because it is fragile and beautiful, but whose hostility and dirtiness influence the child's appreciation through direct contact. These perceptions are coupled with typical divergent commitments to protect and avoid or to fight nature. The analysis of the verbatims reveals contradictions that run through these students during the program and provides valuable insight into explaining the lack of significant change in quantitative results.

Indeed, the qualitative analysis makes it possible to highlight an evolution in the ethical positioning of the program's beneficiaries and to underline the importance of past experiences on the relationship that a student may have with nature. This past experience, individually forged by the family sphere, is often summoned as an explanatory element in the interviews (Wüstermann *et al.*, 2016). Indeed, Emma had frequent contacts with nature in the past that allowed her to build prior knowledge, and thus to mobilize it during the program. The program seems to have strengthened her desire to protect nature, but unfortunately, the difficulties in mastering cycling in the wilderness, combined with the prolonged efforts to access it, paradoxically reduced her appreciation of nature.

The same dynamic is reinforced in Oscar, who emphasizes how negative his concrete experiences with nature had been for him. Nevertheless, even though he found nature dangerous, he continued to develop empathy for animals, plants and trees throughout the program. The program thus seems to have had the paradoxical effect of reinforcing already internalized behaviors of protecting nature while generating less appreciation in contact with it for these two students.

Imran seems to develop a different dynamic over the course of the program, which allowed him, by overcoming his fear, to voluntarily seek more contact with a natural environment. However, this development reinforces his anthropocentric attitude, as he sees nature as a playground in which that he enjoys taking control as with the other two actors, the beliefs developed and legitimized within the family sphere (for Imran, that it is his prerogative to decide which creature has the right to exist or instead be eliminated) remain elements conditioning the evolution of his attitudes within the same school program.

However, the attitude toward "using nature" does not appear to have changed over the course of the program. No significant differences were found on Bogner's (2018) questionnaire, and the analysis of the enactive interviews did not clearly identify a dynamic among the actors interviewed. Thus, by combining two distinct educational approaches (Forest School and AE), the Ecolo'coteaux program improved protective attitudes in our three actors, but had no effect on nature use and a negative effect on nature appreciation. There are methodological and practical reasons why this interventional study only partially achieved its objectives.

From a quantitative point of view, the results did not show significant changes in either the control or the test group. However, due to the limited number of participants, it would be necessary to expand the program in order for the tests used to have significant sufficient statistical meaning.

From a practical point of view, the analysis of the program reveals interesting information. However, as this was a teacher-led program, we were unable to attend all of the sessions and our view of its effects remains fragmentary. The contact with nature was perhaps insufficient, despite the duration of the program. Indeed the development of ecocentric attitudes requires frequent and regular contact with nature (Meech, 2014 in Turtle *et al.*, 2015; Armstrong & Impara, 1991) that can generate an attachment to place (Scannell & Gifford, 2010) and a connection to nature (Lumber & al, 2017). The children's verbatims reveal that only the day trips represented salient experiences in this regard. The program flow involved prior mastery of the bicycle before considering more ambitious outings. This design was pedagogically consistent, but it took more than three months to get students out of the urban environment and into nature. Moreover, although there were an exceptional number of field trips in the school environment. It would appear to us that 6 trips were not able to develop a state of attachment to the place insofar as they went to the forest rather late in the program and did not have time to acclimatize to this place and to live experiences that would allow them to have a real connection to nature.

This lack of sufficient exposure to "truly natural nature" (Ingold, 2011), may not have given them time to develop the sense of well-being that contact with nature can provide. In this regard, it is likely that the experience proposed by the educational team could be improved. Indeed, it would be beneficial to devote more time to developing sensitivity to natural elements, especially in the context of adventure education. Unfortunately, this was not evaluated in the program in question and would require further study to be adequately addressed.

However, this study is the first to evaluate the effect of a program combining these two types of pedagogies (Forest School and AE) in the service of a goal of developing pro-environmental attitudes in elementary school children. It is, to our knowledge, the first to highlight this inhomogeneous effect of an immersive interventional program on the environmental attitudes of students. The crossing of methodological views using a mixed method on the course of this program suggests interesting avenues for the design of future programs concerning the inclusion of parents in interventions to support these "family habits" structuring the activity of children in action. It would seem interesting to increase exposure to nature and to plan specific times dedicated to developing

ecocentric attitudes, as changes in concerns have been highlighted qualitatively without any quantitative change in environmental attitudes. These transformations take time and we can consider that the changes of concerns are a first step in this long process.

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